AMENDMENTS TO THE CLAIMS

1. (Original) A communications satellite system for providing communications between a plurality of mobile terminals and a satellite ground station, said system comprising:

at least one orbiting satellite comprising a satellite dual-polarization receiving antenna, said satellite dual-polarization receiving antenna comprising multiple satellite antenna elements that receive first and second polarized signals from said plurality of mobile terminals, wherein said first polarized signals correspond to a first one of said dual polarizations and said second polarized signals correspond to a second one of said dual polarizations;

a first transponder on board said satellite that processes said first polarized signals received from said mobile terminals to convert said first polarized signals to a first feeder link signal for transmission to said satellite ground station using a first feeder link polarization;

a second transponder on board said satellite that processes said second polarized signals received from said mobile terminals to convert said second polarized signals to a second feeder link signal for transmission to said satellite ground station using a second feeder link polarization;

a ground-station dual-polarization receiving antenna at said satellite ground station that receives said first and second feeder link signals, said ground-station dual polarization receiving antenna comprising multiple ground-station antenna elements that receive said first and second feeder link signals from said satellite;

a dual-channel receiver connected to said ground-station dual-polarization receiving antenna that amplifies, filters, downconverts, and digitizes the received first and second feeder link signals to produce numerical sample streams corresponding to said received first and second feeder link signals received at each of said multiple satellite antenna elements and each of said dual-polarizations; and

a diversity demodulator connected to said dual channel receiver that combines said numerical samples streams to reproduce information transmitted by said plurality of mobile terminals.

2. (Original) The system of claim 1 wherein said satellite dual polarization receiving antenna is a Direct Radiating Array comprised of dual-polarization array elements.

3. (Original) The system of claim 1 wherein said satellite dual polarization receiving antenna comprises multiple dual-polarization antenna feed elements and a reflector.

4. (Original) The system of claim 3 wherein said multiple dual-polarization antenna feed elements are located out of the focal plane of said reflector.

5. (Original) The system of claim 3 wherein said multiple dual-polarization antenna feed elements are coupled using a Butler matrix.

6. (Original) The system of claim 4 wherein selected subgroups of said multiple dual-polarization antenna feed elements are coupled using Butler matrices of reduced complexity.

7. (Original) The system of claim 1 wherein said first and second transponders downconvert received signals from each of said multiple satellite antenna elements to the complex baseband to obtain corresponding In-phase (I) and Quadrature (Q) signals.

8. (Original) The system of claim 7 wherein said first and second transponders each use quadrature time-division multiplexing to multiplex said (I,Q) signals corresponding to the same

polarization of different antenna elements to obtain a first and a second feeder link baseband signals.

9. (Original) The system of claim 8 wherein said first feeder link baseband signal is upconverted to a first feeder link frequency to obtain said first feeder link signal and said second feeder link baseband signal is upconverted to a second feeder link frequency to obtain said second feeder link baseband signal.

10. (Original) The system of claim 9 wherein said first and second feeder link frequencies are the same frequency.

11. (Original) The system of claim 1 wherein said numerical sample streams at said ground station comprise complex numerical samples having a real (Inphase or I) part sample stream and an imaginary (Quadrature or Q) part sample stream.

12. (Original) The system of claim 11 wherein said dual channel receiver uses quadrature time-division demultiplexing to demultiplex the signal from each channel to thereby obtain said complex (I, Q) numerical sample streams.

13. (Original) The system of claim 1 wherein said diversity demodulator combines said numerical samples streams using beamforming controlled by a number of complex beamforming coefficients.

14. (Original) The system of claim 13 wherein the number of said beamforming coefficients used at any instant is equal to the product of the number of said numerical sample streams

times the number of signals from said plurality of mobile terminals received on the same frequency channel at said at least one orbiting satellite at said any instant.

15. (Original) The system of claim 13 further comprising a beamformer and beamforming coefficients corresponding to each of said dual polarizations.

16. (Original) The system of claim 13 wherein said beamforming coefficients optimize demodulation of information from each of said plurality of mobile terminals independently.

17. (Original) The system of claim 15 further comprising a separate demodulator for each signal simultaneously received on a given frequency channel from said plurality of mobile terminals that further combines outputs from said beamformers to decode information from one of said plurality of mobile terminals.

18. (Original) The system of claim 17 wherein said separate demodulator uses combining coefficients estimated with the aid of known symbols included in transmissions from said plurality of mobile terminals.

19. (Original) The system of claim 13 wherein said beamforming coefficients are fixed and correspond to optimizing reception from a set of fixed directions.

20. (Original) The system of claim 16 wherein said beamforming coefficients are fixed and correspond to optimizing reception from a number of fixed directions, and said plurality of mobile terminals are allocated to use a set of said beamforming coefficients corresponding to optimum reception from the direction in which each of said plurality of mobile terminals location most closely corresponds.

21. (Original) The system of claim 1 wherein said diversity demodulator comprises a separate demodulator and decoder for each signal received simultaneously on a given frequency channel from said plurality of mobile terminals.

22. (Original) The system of claim 21 wherein each of said separate demodulators jointly process information received in a timeslot allocated to one of said plurality of mobile terminals together with information received in a timeslot which is allocated to the same one of said plurality of mobile terminal in some TDMA frames and to a different one of said plurality of mobile terminals in other TDMA frames.

23. (Original) The system of claim 1 wherein said diversity demodulator combines samples corresponding to different satellite antenna elements, different polarizations, and different timeslots using weighting coefficients to optimize decoding of information received from each of said plurality of mobile terminals.

24. (Original) The system of claim 1 wherein said diversity demodulator is adapted to perform digital channel splitting to separate each of said numerical sample streams into numerical sample streams of reduced sample rate, each numerical sample stream of reduced rate corresponding to one of a number of frequency channels.

25. (Original) The system of claim 24 wherein said diversity demodulator further is adapted to perform digital beamforming for each of said frequency channels to combine ones of said numerical sample streams of reduced sample rate corresponding to the same frequency channel.

26. (Original) A communications satellite system for providing communications between a plurality of mobile terminals and a satellite ground station, said system comprising:

at least two orbiting satellites each comprising a multi-element, dual-polarization receiving antenna comprising multiple satellite antenna elements that receive signals from said plurality of mobile terminals, each of said satellites having a dual-channel transponder that transponds signals received by each of said multiple satellite antenna elements so as to preserve relative phase and amplitude between signals from different satellite antenna elements of the same satellite;

at least one ground station comprising at least two receiving antennas each said receiving antenna being orientated toward a corresponding one of said at least two satellites to receive transponded signals transmitted from said corresponding satellite to said ground station;

a diversity receiver at said at least one ground station for jointly processing transponded signals transmitted from said at least two satellites and received by said at least two receiving antennas to decode information transmitted by said mobile communications terminals.

27. (Original) The system of claim 26 wherein said multi-element satellite antennas for each of said orbiting satellites are Direct Radiating Arrays comprised of dual-polarization array elements.

28. (Original) The system of claim 26 wherein said multi-element satellite antennas for each of said orbiting satellites comprise multiple dual-polarization antenna feed elements and a reflector.

29. (Original) The system of claim 28 wherein respective ones of said multiple dual-polarization antenna feed elements are located out of the focal plane of said reflector.

30. (Original) The system of claim 28 wherein respective ones of said multiple dual-polarization antenna feed elements are coupled using a Butler matrix.

31. (Original) The system of claim 29 wherein selected subgroups of each of said multiple dual-polarization antenna feed elements are coupled using Butler matrices of reduced complexity.

32. (Original) The system of claim 26 wherein each of said dual channel transponders uses quadrature time division multiplexing to preserve relative phase and amplitude between signals from different satellite antenna elements of the same satellite.

33. (Original) The system of claim 26 wherein said diversity receiver comprises:

a plurality of demultiplexers for separating signals received from each satellite into separate signals corresponding to different satellite antenna elements; and

a plurality of channelizers for further separating each of said separated signals by frequency channel to obtain channelized signals.

34. (Original) The system of claim 33 further comprising a plurality of beamformers for each of said frequency channels to combine ones of said channelized signals corresponding to the same frequency channel to obtain beamformed signals.

35. (Original) The system of claim 34 further comprising a plurality of diversity demodulators for combining ones of said beamformed signals corresponding to the same frequency channel

and beam direction but different satellites to decode information transmitted by said mobile communications terminals.

36. - 50. Cancel